**ACTIVITY: Using shadows to build 3D images**

**Activity idea**

In this activity, students model how scientists interpret microscope data by using shadows of an object from different angles to build up a 3D image.

By the end of this activity, students should be able to:

* describe how they used shadow outlines of an object viewed from different angles to build up a 3D image
* explain how this process relates to actual data interpretation when using microscopes and other imaging techniques
* describe how 2D representations of 3D objects can be misleading.

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**Introduction/background notes**

***Interpreting scientific data***

Nearly every scientific endeavour involves the collection of data. Data is simply a set of observations and is of little use until it is interpreted. Interpreting data is a skill. To do so accurately requires knowledge about the subject under investigation and the methods used to investigate it.

When scientists use microscopes and other imaging technologies, the data is often in the form of 2D images. Electron tomography, CT and microCT take images from the whole thickness of a sample (rather than using a series of thin slices). The images are taken from different angles and help scientists to build up a 3D image. This activity gives students an idea of what it is like to interpret 2D data while trying to build up an accurate 3D image. The student version is rather low-tech when compared to electron microscopy, but it should get the idea across.

Students might like to try a second method of building 3D images from 2D data with the student activity [Using lolly slices to build 3D images](https://www.sciencelearn.org.nz/resources/521-using-lolly-slices-to-build-3d-images).

**What you need**

* Images of object shadows in [What is this object?](#what)
* Access to the video [Interpreting microscope data](https://www.sciencelearn.org.nz/videos/302-interpreting-microscope-data)
* Overhead projector (OHP)
* Small objects to use on the OHP

**What to do**

1. Begin by showing the images on the first page of [What is this object?](#what) These are shadows of an object placed on the surface of an OHP and rotated to capture views from the top, bottom, sides or at an angle.
2. Once students have made their predictions, show the images of the objects on the second page of [What is this object?](#what) The first object (bath plug) should be easy to identify. The second (broccoli) poses more of a challenge. The third object (a Lego platform with multiple figures) is likely to be too complex for students to guess. Students may be able to infer that Lego is involved, due to some identifiable shapes.
3. Discuss how students came to guess each object based on the 2D shadows/images taken from different angles. (Familiarity with the object is the most likely answer. There are no colour clues when using shadows.)
4. Discuss the angles and/or views of each object and what kind of information the viewer can obtain. (For example, only one view of the broccoli lets us determine there are at least three branches.)
5. View the video [Interpreting microscope data](https://www.sciencelearn.org.nz/videos/302-interpreting-microscope-data). Discuss some of the points Alan Mitchell raises and refer to the shadow images to illustrate these points:

* The importance of understanding the sample well enough to be able to interpret what one sees.
* Enormity of information available.
* Sample preparation.
* Introducing bias.

1. Continue the activity by placing objects on the OHP and asking students to guess what they are. Place a screen (for example, a textbook) in front of the OHP so students cannot peek. Place the item on the glass plate before turning the light on. Turn off the light while rotating the object between views. If the object will not balance on its own, use a small amount of Blu-Tack to attach it to the plate. Ensure the Blu-Tack does not interfere with the object’s actual shadow.

**Discussion questions**

* How is this activity similar to what scientists actually do when using electron tomography, CT and microCT? (Both the OHP and the microscopes show 2D images taken from different angles through the whole thickness of a sample. These can be used to build up a 3D image.)
* How does this activity differ from what scientists actually do when using these microscopy techniques? (The OHP has relatively little magnification and poor resolution compared to microscopes. Resolution increases the amount of detail we can see. The OHP simply casts a shadow; there is no surface detail or colour.)
* Were you accurate in all of your predictions? Were some images misleading? Do you think that scientists using sophisticated microscopes can also find 2D images misleading when trying to build a 3D image?

**Extension ideas**

Check out the interactives [Which microscope?](https://www.sciencelearn.org.nz/image_maps/100-which-microscope) and [From mountains to microscopes](https://www.sciencelearn.org.nz/image_maps/8-from-mountains-to-microscopes) to learn more about the techniques and uses of various microscopes.

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**What is this object?**

